ELEMENTAL ANALYSIS OF FRESH WATER ALGAE, MICROSPORA

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ABSTRACT: In this study, the elemental composition of very important freshwater green algae genus Microspora was investigated. Microspora stagnorum and Microspora amoena are the main subjects of the investigation. Utilizing an atomic absorption spectrophotometer (AAS), these algae plants were gathered from multiple sites in Hyderabad, Sindh, Pakistan. Microspora stagnorum had the highest amounts of sodium 31.853±2.139a, iron 9.890±0.664b, calcium 0.233±0.0 015d, zinc 0.315±0.023d, potassium 1.834±0.123c, potassium 2.636±0.077c, zinc 0.202±0.024c, and iron 15.483±1.881b, that the Microspora amoena (Kutzing) Rabenhorst sample has a comparatively high levels of sodium [Na] (45.511 ± 5.652 percent), iron [Fe] (16.483 ± 1.881 percent), potassium [K] (3.757 ± 0.335 percent), and iron [Fe] (26.483 ± 1.881 percent). However, at 0.536 ± 0.077 percent, the zinc [Zn] content was the lowest. Because of their high mineral content, the study showed that microspore species could be used as dietary supplements. Furthermore, these algae can be used as bioindicators for environmental monitoring and bioremediation processes.

Keywords: Fresh Water Algae, Elemental analysis, Atomic Absorption Spectrophotometry (AAS),

(Received 26.07.2025 Accepted 13.09.2025)

INTRODUCTION

The prospect of harnessing algae as a rich source of vital nutrients has garnered significant attention in recent years, with researchers like (Richmond 2004), Pulz and Gross 2004), and Becker 2007) highlighting their rapid growth rates and adaptability to diverse aquatic environments. This investigation zeroes in on the elemental composition of Microspora, a genus of green algae thriving in freshwater ecosystems. The omnipresent water cover on our planet, accounting for approximately 70% of its surface, supports an astonishing array of aquatic plant species. Freshwater algae, forming the backbone of the food chain and driving primary production, show a essential role in maintaining the delicate balance of aquatic ecosystems (Wetzel, 2001; Reynolds, 2006; Bellinger and Sigee, 2010). Their remarkable ability to bioaccumulate both essential and non-essential elements renders them valuable bioindicators for environmental monitoring (Rai et al., 2013). To fully grasp the nutritional value of algae and their potential applications in agriculture, human and animal diets, and other fields, it is crucial to analyze their elemental composition (Genter et al., 2014).Within the Microsporaceae family, the genus Microspora is widely distributed across freshwater environments, with its filamentous green algae boasting a straightforward structure and an impressive capacity to colonize various aquatic habitats. Previous studies have revealed the presence of vital minerals such as calcium (Ca), iron (Fe), potassium (K), sodium (Na), and zinc (Zn) in several algae species (Wu et al., 2015). By quantifying the levels of these elements in Microspora species, we can better evaluate their potential as nutritional supplement sources and their role in bioremediation. This study focuses on the elemental makeup of four Microspora species – Microspora amoena, Microspora stagnorum, Microspora willeana, and Microspora tumidula – collected from various aquatic locations in Sindh, Pakistan. Using Atomic Absorption Spectrophotometry (AAS), we measured the concentrations of Zn, Fe, K, Na, and Ca in these species. The findings of this research will significantly contribute to our understanding of the nutritional profile of these algae and their potential applications in various industries.

MATERIAL AND METHOD

All The research work study was competed in the phycology research laboratories of institute of plant science university of Sindh and National Soil Research Institute, Tandojam. The elemental characteristics of the following algae belonging to different genera were determined. Microspora amoena (Kutzing) Rabenhorst and Microspora stagnorum (Kutzing) Lagerheim.

Collection points: The algal plants materials were collected in February 2024 from various sites of Sindh Almanzar, River Indus (Jamshoro) Different fresh water pools of Hyderabad City Microspore are rich in nutrients and elements, such as potassium, oxygen, copper, zinc, hydrogen, sodium, magnesium and iron. These Microspore species collected from different places of Hyderabad

Digestion of the algal Material: The algae was first dried at room temperature in the shade, and then it was baked for one hour at 60 to 80 degrees Celsius. Ten milliliters of HNO3 were used to carefully dissolve one gram of manually crushed sample material, and the mixture was then allowed to digest for eight hours. After that, the sample's acid solution was gradually heated on a hot plate between 100 and 120 oC until it was almost dry. As the sample cooled, it was once more digested using 8 milliliters of HNO3 and H2O2 (2:1). It was then dried by placing it on a hot plate set between 100 and 120 degrees Celsius until only 1 milliliter of sample was left. After cooling, 24 ml of double-distilled water was added to the sample, diluting it to a total volume of 25 ml. Bright yellow should be the color of the diluted sample; if not, the solution was filtered through Whatman filter paper .42.

Elemental Assay: The Nuclear Institute of Agriculture (NIA), Tando Jam, used an Atomic Absorption Spectrophotometer (AAS) to analyze the samples of algal material belonging to the Microspora genus species. Each element was examined one at a time using a precise and appropriate standard solution. As stated by Marry and Franson (1992), the Analytic Jena-Germany, Model AAS-vario-6, used the direct air acetylene flame method for sample/solution purposes on an atomic absorption spectrometer. In the course of this investigation, every element in the freshwater alga Microsporum sp.

Methodology For Detection of Elements From Fresh Water Green Algae: Material collection, washing of the tape water, followed by distilled water, weighing of the dried material, digestion with 10 ml of nitric acid for 8 hours, ashing at 100 to 12oC, addition of HNO3 and H2O2 (2:1), rehashing up to 1 ml of the dried sample, adding 24 ml of D.D water to make 25 ml, and preparation of the sample for the elemental analysis using AAS.

RESULTS AND DISCUSSION

The elements of five elements—zinc (Zn), iron (Fe), potassium (K), sodium (Na), and calcium (Ca)—were found to be significantly higher in Microspora species of freshwater green algae, such as Microspora amoena (Kutzing) Rabenhorst and Microspora stagnorum (Kutzing) Lagerheim. If these algae were processed and used in human food, the iron content would be lower. Table_ provides information on the above elements of several species of the genus Microspora.

Microspora Amoena (Kutzing) Rabenhorst: A number of elements have been identified in samples of Microspora amoena (Kutzing) Rabenhorst, a species of Microspora, including Zn, Fe, K, Na, and Ca. Microspora amoena (Kutzing) Rabenhorst samples had substantially varied Zn, Fe, K, Na, and Ca concentrations ($P < 0.05$), according to statistical analysis ($DF = 19$, $F = 240.11$, $P < 0.01$, $CV = 18.25$ percent). It is clear from (Table 1)that the Microspora amoena (Kutzing) Rabenhorst sample has a comparatively high levels of sodium [Na] (45.511 ± 5.652 percent), iron [Fe] (16.483 ± 1.881 percent), potassium [K] (3.757 ± 0.335 percent), and iron [Fe] (26.483 ± 1.881 percent). However, at 0.536 ± 0.077 percent, the zinc [Zn] content was the lowest. The findings also revealed that the microspore species Microspora amoena (Kutzing) Rabenhorst had the greatest sodium (Na) concentration among the elements examined in the samples, followed by iron, potassium, and calcium, and the lowest zinc (Zn) level. The elements in Microspora amoena (Kutzing) Rabenhorst are arranged as follows: Na > Fe > K > Ca > Zn. Microspora amoena (Kutzing), the Rabenhorst species, provides plenty of food for the ordinary individual.

Table. 1. Concentration of certain elements in Microspora amoena (Kutzing) Rabenhorst

S. No	Elements	Symbol	Samples (1 g each sample)				Mean
			S1	S2	S3	S4	
1.	Zinc	Zn	0.200	0.232	0.172	0.204	$0.536{\pm}0.024^c$
2.	Iron	Fe	15.330	17.783	13.184	15.637	$16.483{\pm}1.881^b$
3.	Potassium	K	2.73	3.17	2.35	2.77	$3.737{\pm}0.335^c$
4.	Sodium	Na	46.050	53.418	39.603	46.971	$45.511{\pm}5.652^a$
5	Calcium	Ca	0.630	0.731	0.542	0.643	$1.636{\pm}0.077^c$

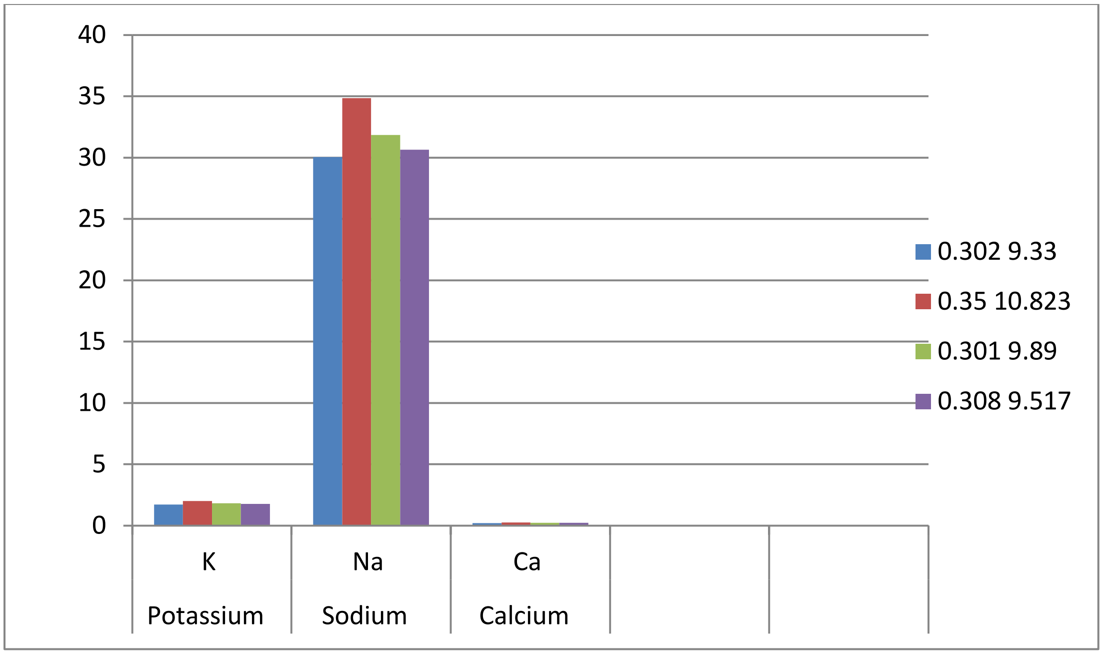

Figure.1 Concentration of certain elements in *Microspora amoena* (Kutzing) Rabenhorst

Table 2. Concentration of certain elements in *Microspora Stagnorum* (Kutzing) Lagerheim

S. No.	Elements	Symbol	Samples (1 g each sample)				Mean
			S1	S2	S3	S4	
1.	Zinc	Zn	0.302	0.350	0.301	0.308	0.315±0.023[d]
2.	Iron	Fe	9.330	10.823	9.890	9.517	9.890±0.664[b]
3.	Potassium	K	1.73	2.01	1.83	1.77	1.834±0.123[c]
4.	Sodium	Na	30.050	34.858	31.853	30.651	31.853±2.139[a]
5.	Calcium	Ca	0.220	0.255	0.233	0.224	0.233±0.015[d]

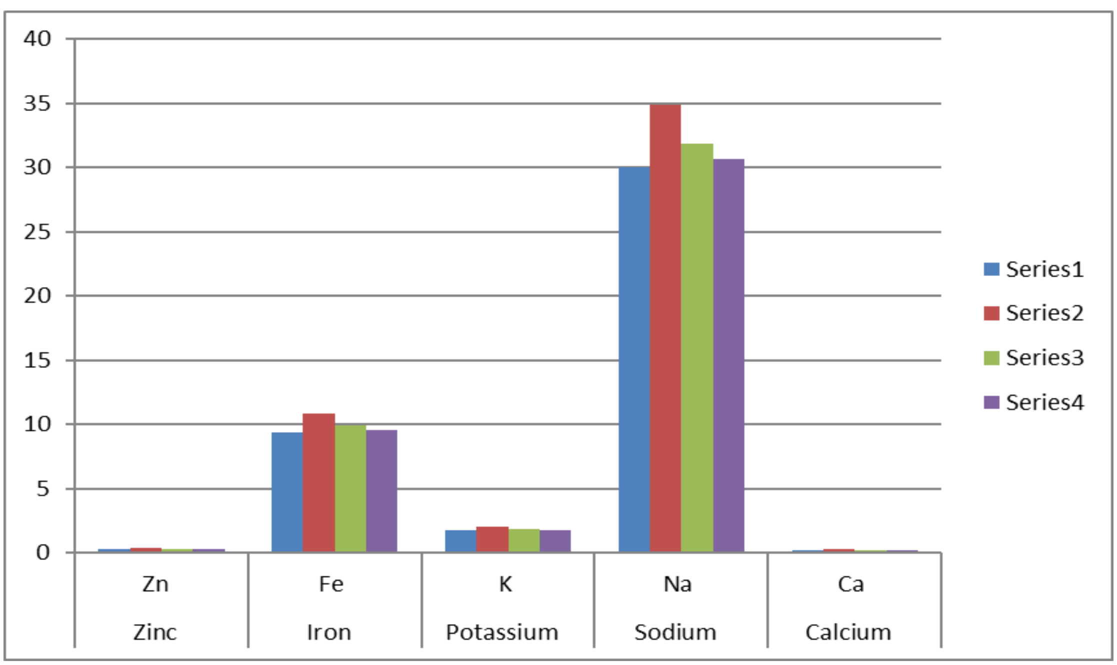

Figure.2 Concentration of certain elements in *Microspora stagnorum* (Kutzing) Lagerheim.

***Microspora Stagnorum* (Kutzing) Lagerheim:** Zn, Fe, K, Na, and Ca concentrations were measured using the genus Microspora stagnorum (Kutzing) Lagerheim. Microspora stagnorum (Kutzing) Lagerheim samples showed a highly significant difference in Zn, Fe, K, Na, and Ca contents ($P < 0.05$) according to ANOVA statistical analysis (DF = 19, F = 887.33, $P < 0.01$, CV = 10.25 percent). Microspora stagnorum (Kutzing) Lagerheim samples showed the greatest concentrations of sodium [Na] (31.853 ± 2.139 percent), followed by zinc [Zn] (0.315 ± 0.023 percent), potassium [K] (1.834 ± 0.123 percent), and iron [Fe] (9.890 ± 0.664 percent) (Table 2). Conversely, the lowest concentration was that of calcium [Ca] (0.233 ± 0.015 percent). The species Microspora stagnorum (Kutzing) Lagerheim was also discovered to have the greatest concentration of sodium among the elements analysed, followed by potassium, zinc, and iron, while calcium had the lowest concentration. Based on the concentration levels in Microspora stagnorum (Kutzing) Lagerheim, the elements were categorised as follows: Na> Fe>K>Zn>Ca. More research is required to confirm the species' balanced use for human nutrition in cases of Ca/Zn insufficiency and iron adequacy, even though samples of the green algae species Microspora stagnorum (Kutzing) Lagerheim had the lowest calcium and zinc concentrations. Each element's concentration in Microspora stagnorum (Kutzing) Lagerheim is showed in (Table 2).

DISCUSSION

Elemental analysis was conducted on four species of freshwater green algae: Microspora amoena (Kutzing) Rabenhorst, Microspora stagnorum (Kutzing) Lagerheim, Microspora willeana Lagerheim, and Microspora tumidula Hazen. The investigation focused on five key elements: calcium (Ca), sodium (Na), potassium (K), iron (Fe), and zinc (Zn).

The results revealed that Microspora stagnorum (Kutzing) Lagerheim had the lowest zinc (Zn) content, with a concentration of 0.315±0.023, followed closely by Microspora willeana Lagerheim (0.304±0.037), Microspora tumidula Hazen (0.268±0.033), and Microspora amoena (Kutzing) Rabenhorst (0.202±0.024).

In contrast, Microspora amoena (Kutzing) Rabenhorst exhibited a significantly higher iron content compared to the other three species, with a concentration of 10.433±1.268, whereas Microspora stagnorum (Kutzing) Lagerheim, Microspora tumidula Hazen, and Microspora willeana Lagerheim had lower iron contents, ranging from 9.141±1.111 to 9.890±0.664.

The potassium (K) content was relatively consistent across the four species, with Microspora amoena (Kutzing) Rabenhorst displaying the highest concentration (2.807±0.335), followed by Microspora willeana Lagerheim (2.757±0.335), Microspora stagnorum (Kutzing) Lagerheim (1.834±0.123), and Microspora tumidula Hazen (1.717±0.208).

Notably, Microspora amoena (Kutzing) Rabenhorst had the highest sodium (Na) concentration (46.511±5.652), significantly exceeding the levels found in the other three species. The calcium (Ca) content was relatively low across all species, with Microspora stagnorum (Kutzing) Lagerheim exhibiting the highest concentration (0.233±0.015).

The findings of this study are consistent with previous research on the elemental composition of freshwater green algae. For instance, studies by Iqbal et al., Baruah et al., Rou and Borah, Kumar and Sahu, Choudhary, and Deb et al. have reported similar sodium (Na) concentrations in algae samples.

Conclusions: Every species had comparatively low zinc concentrations, but Microspora stagnorum had the highest, albeit still low, zinc content. Iron (Fe) content: Compared to other species, Microspora amoena had the highest Fe content. This implies that if incorporated into the human diet, particularly as an iron supplement, there may be nutritional advantages. Microspora amoena and Microspora willeana both had the greatest potassium (K) levels. The potassium (K) concentrations in the remaining species were comparable, albeit slightly lower, implying a relatively consistent rate of K utilization within the genus. Notably, Microspora amoena exhibited significantly higher sodium (Na) content compared to its counterparts. This elevated sodium level may limit its suitability for certain dietary applications, given the potential health risks associated with excessive sodium intake. Conversely, all other species displayed remarkably low calcium (Ca) values, with Microspora amoena again showcasing the highest Ca concentration. Microspora amoena demonstrates promise as a rich source of potassium and iron. The potassium content can contribute to maintaining cardiovascular health, while its high iron content makes it an attractive option for addressing iron deficiency. However, the high sodium content in Microspora amoena warrants caution, particularly for individuals with salt sensitivities or related health conditions. To make Microspora amoena more suitable for human consumption, selective breeding or additional processing methods could be employed to reduce its salt content. Further investigation is necessary to determine the bioavailability of these elements in human and animal diets and to explore strategies for balancing the elemental composition, particularly in species with high salt and low calcium levels. These algae species can be cultivated as aquaculture additives or biofertilizers to enhance the nutritional value of fish, presenting opportunities for innovative applications in agriculture and environmental sustainability.

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